GLAST LAT SPECIFICATION	Document # **LAT-MD-00272-02**	Date Effective 9 April 2001
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	Subsystem/Office Calorimeter Subsystem	
Document Title **Calorimeter Grounding and Shielding Plan**		

Gamma-ray Large Area Space Telescope (GLAST)

Large Area Telescope (LAT)

Calorimeter

Grounding and Shielding Plan

DOCUMENT APPROVAL

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CHANGE HISTORY LOG

Revision	Effective Date	Description of Changes
2	9 April 2003	Show grounding to carbon composite structure

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List of Figures

1 PURPOSE

This document describes the grounding and shielding plan for the GLAST Large Area Telescope (LAT) Calorimeter subsystem.

2 SCOPE

This document gives an overview over the conceptual architecture of the GLAST LAT Calorimeter Readout Control (GCRC) ASIC.

3 DEFINITIONS

3.1 Acronyms

ACD – AntiCoincidence Detector Subsytem of LAT

ADC – Analog to Digital Converter

CAL – Calorimeter Subsystem of LAT

GCFE – Glast Calorimeter Front-end electronics ASIC

GCRC – GLAST Calorimeter Readout Control ASIC

GLAST – Gamma-ray Large Area Space Telescope

LAT – Large Area Telescope

TBR – To Be Resolved

TEM – Tower Electronics Module

TKR – Tracker Subsystem of LAT

3.2 Definitions

4 APPLICABLE DOCUMENTS

Documents that are relevant to the development of the CAL Electronics concept and its requirements include the following:

4.1 Requirement Documents

GLAST00010, “GLAST Science Requirements Document”, P.Michelson and N.Gehrels, eds., July 9, 1999.

LAT-SP-00010, “GLAST LAT Performance Specification”, August 2000

LAT-SS-00018, “LAT CAL Subsystem Specification”, January 2001

4.2 Conceptual Design Documents

[1] GLAST Calorimeter Analog Front-End ASIC Design Consideration, Neil Johnson, NRL

[2] Calorimeter Front End ASIC – Conceptual Design, Gunther Haller

[3] LAT Electronics System – Conceptual Design

[4] LAT Calorimeter Electronics System

[5] LAT GCFE Specification

[6] LAT TKR-CAL Tower Electronics Module – Conceptual Design

[7] LAT Control Protocol within LAT – Conceptual Design

[8] Calorimeter Readout Control ASIC – Conceptual Design, Jim Ampe

5 INTRODUCTION

The *GLAST* electronics system is described in [3]. The calorimeter sub-system electronics is documented in [4]. A carefully chosen grounding plan for the Calorimeter is required for low noise sensitivity of the detectors, in addition to not causing interference to the other subsystems. The shielding is also important for protecting the Calorimeter's electrical signals and detectors from outside electromagnetic interference, and reciprocally ensuring that the calorimeter does not interfere with other subsystems. The grounding and shielding are described together because the shield is a conductor, and all of the electrical connections in and out of the instrument need to be defined in a grounding plan.

6 Cal Grounding and Shielding Description

6.1 Grounding and Shielding Overview

The LAT instrument is designed as a modular instrument. Sixteen nearly identical towers are placed in a square array to form the instrument telescope. The mechanical grid to which all the towers attach, forms the mechanical, thermal and electrical connection between modules. A simplified diagram of the tower interconnections is shown in Figure 1

Each tower will have it's own power supply, and communication between towers will be by differential signaling, thus no signal ground needs to be shared between towers.

Each subsystem of a tower (e.g. CAL, TKR, ACD) will have separate power supply secondaries and communication to a common computer will be through differential signaling, thus no common signal ground needs to be shared between instruments on a tower.

Each instrument on a tower separately bolts to the common grid frame, ensuring that each instruments shielding is not mechanically or electrically connected.

With the above described mechanical and electrical configuration of all LAT instruments having a common mechanical and system ground connection in the common grid, we can describe the grounding and shielding plan of all the calorimeter modules by defining the grounding and shielding of a single calorimeter module.

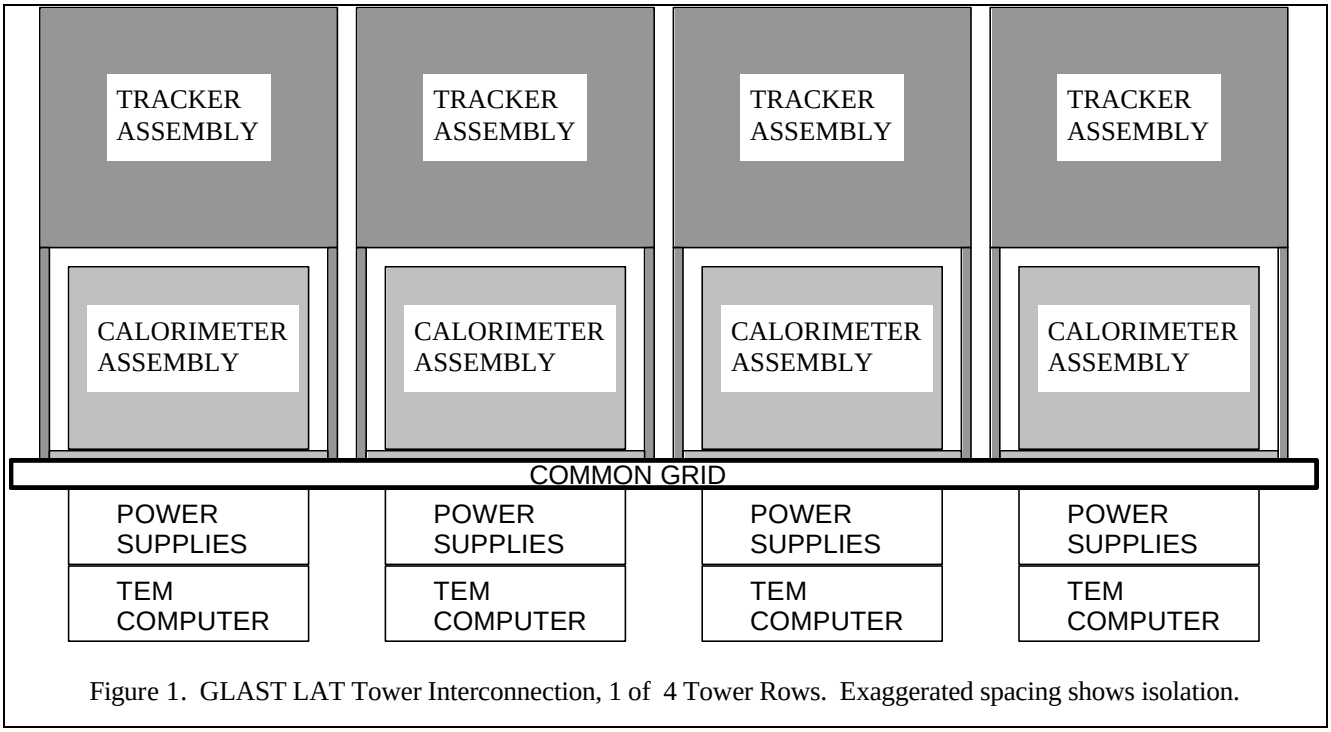

Figure 1. GLAST LAT Tower Interconnection, 1 of 4 Tower Rows. Exaggerated spacing shows isolation.

6.2 Single Tower Calorimeter Construction

The calorimeter consists of carbon fiber matrix core between top and bottom aluminum load plates. The sides of the carbon fiber matrix are surrounded by two layers of thin aluminum panels. The inner panel is the calorimeter closeout plate, and the outer panel is the shear panel. The Calorimeter electronics are mounted between the closeout plates and the shear panels. The power supply and TEM Electronics boxes are mounted directly to the Calorimeter bottom load plate. For thermal and electrical concerns, The TEM and Power Supply boxes attachment points are as close as possible to the calorimeter grid attachment points.

All of the calorimeter frame and shield components are mechanically and electrically connected:

Carbon composite matrix

Top and bottom load plates

Closeout plates

Shear panels

Power supply and TEM case

The PIN diodes mounted within the inner closeout plate and connect to the calorimeter circuit board by short flexible circuit cables. A slot in the inner closeout plate is provide for each flexible cable. Neither the diode nor the flexible interconnect has an electrical connection to the calorimeter structure. There are 48 diodes per calorimeter side mounted in this manner.

The power connection and signal communication to the calorimeter are through cables that connect to the TEM computer and Power Supplies mounted below each calorimeter. The TEM communication signals and Power Supply connection is done through separate connectors. Neither of these two cables have a direct electrical connection to the calorimeter structure. Each calorimeter side circuit board has its own power and communication

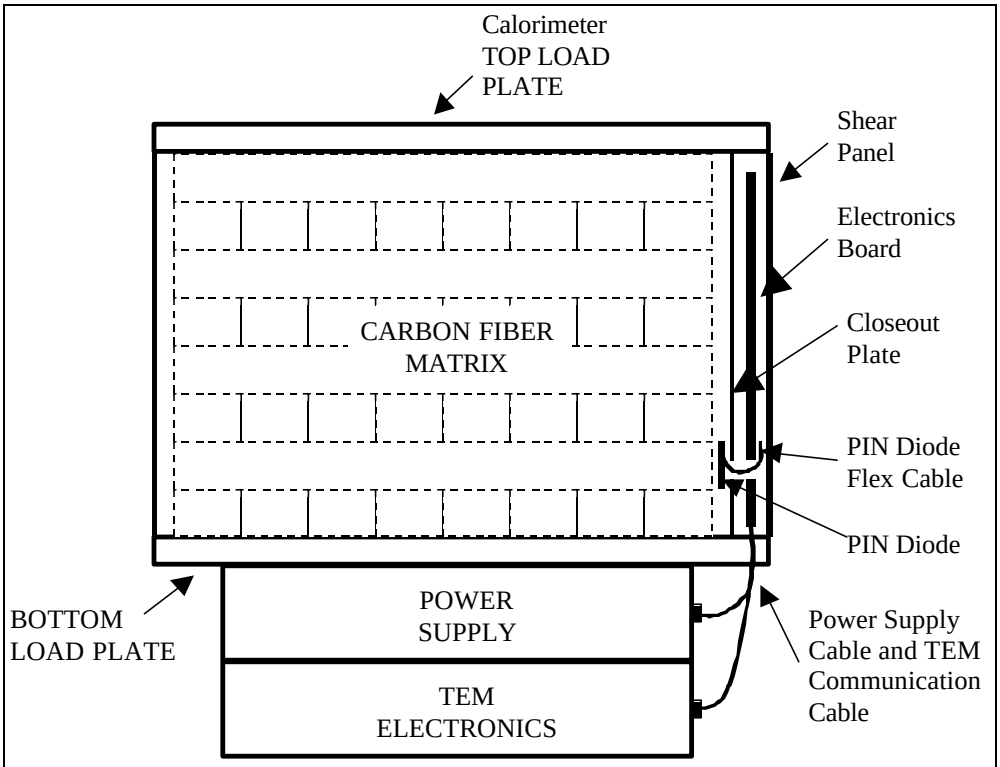

Figure 2. Calorimeter Construction Diagram. Right wall shows placement order of the diode, closeout plate, circuit board, and shear panel. All cases electrically connected.

6.3 Calorimeter Grounding Diagram

The grounding diagram follows from the following analysis:

1) To minimize capacitive noise pickup in the PIN diodes, all conductors and partial conductors near the diode shall be at a fixed potential with regard to the diode. Therefore the closeout plate and the diode ground are electrically connected to the PCB signal ground.

2) The closeout plate is mechanically and electrically connected to the carbon fiber matrix and the shear panel, thus connecting the calorimeter enclosure and shield to signal ground.

3) The Power Supply and TEM Electronics enclosure are mechanically and electrically connected to the calorimeter enclosure. Therefore the Power Supply and TEM Electronics enclosures are connected to calorimeter signal ground.

4) The Power Supply power ground may or may not be connected to the Power Supply enclosure. The lowest noise configuration will be used.

Figure 3 shows a diagram of the grounding connections described above.

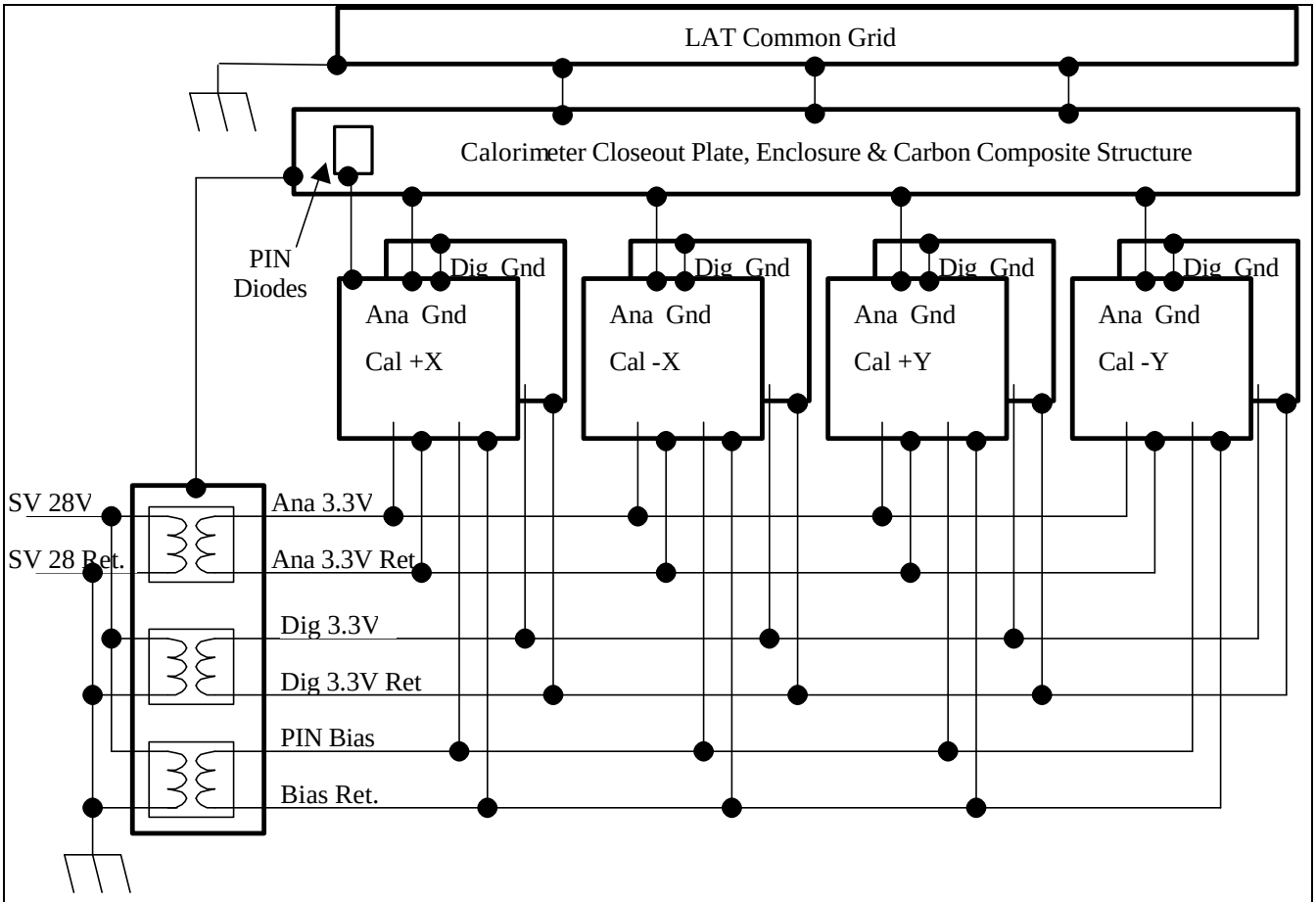

Figure 3. Calorimeter Grounding Diagram

6.4 Front-end Grounding Diagram

The grounding diagram for the front-end electronics is detailed in Figure 4. The PIN diode is AC reference to the analog ground through the Bias Capacitor. The separate analog and digital grounds are connected together at each Analog to Digital Converter (ADC).

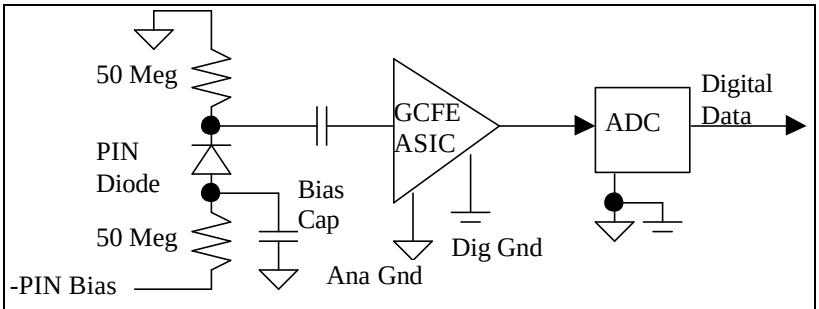

Figure 4. Front end grounding scheme. 1 of 48 per AFEE Board.